

**A Summary of the Graduate Programs
in the Petroleum Engineering Department, Stanford University ****

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1.0 Introduction

Although information on a university may be obtained from bulletins and handbooks that are published by the school, first hand experience can be more reliable and accurate. This summary aims to briefly describe the graduate programs in the petroleum engineering department, Stanford University, with my own PhD program as an example. Another objective of this paper is to encourage other lecturers to present their graduate school experience. In this way, the different graduate programs may be compared to help in providing guidelines for the petroleum engineering graduate programs at the Universiti Teknologi Malaysia. Lecturers who are contemplating graduate work may also gain some insight. It is also useful to compare the actual PhD programs with the approval procedure used in the PhD program under the 'Skim latihan akademik bumiputra' (SLAB).

The entrance qualifications to Stanford are clearly listed in the Stanford University's bulletin and, therefore are not discussed here.

2.0 Application

Apart from the usual transcripts and recommendation letters, a one page research interest areas is required. The information asked is: previous research conducted, papers published, current research areas, proposed PhD research area. It is necessary to know an applicant's area of research to ensure that facilities are available and professors can be identified.

Time permitting, the prospective student corresponds with the professor whose research areas coincide with the candidate's interests. Sometimes, a topic is decided upon before enrollment. However, in general most students do not have a topic beforehand.

3.0 Program Schedule

Different departments may have different schedules and requirements. Presented here are typical schedules of students in the petroleum engineering department.

3.1 PhD program

During the first quarter, all professors present their research topics. Students are also encouraged to discuss research topics with individual professors. Not much or very little research work is done since students tend to take a heavy coursework load.

During the second quarter, most students especially research assistants (RA) would have started literature review. Scholarship students take more courses than RAs and may still be looking for a

topic. During this time, students attend seminars to get research ideas. By the end of the quarter, all students would have a topic and a research advisor.

In spring (3rd quarter), in addition to the coursework, some research is conducted. In summer, all PhD students prepare for the qualifying examinations, and may try out their research ideas.

During the fifth quarter, the coursework load is less and more research is done. More detailed work such as programming, and designing of equipment are carried out.

Coursework requirement is usually completed by the sixth quarter for full scholarship students, and by the eighth quarter for RAs. Students may continue taking courses for credit even when the coursework requirement is satisfied. These additional courses are, usually, in areas that are relevant to the research topic. I had to follow courses on parallel/concurrent programming which were in the area of my research.

The scope of the research topic tends to change when more investigations are carried out because after six to eight months of work, a student knows what can or cannot be achieved. The research with the narrowed scope, which is one's final research, would usually start after 2-2.5 years after entry.

Those who finished their PhD program in about 3 years or less started writing after 1.5 to two years, and they were in one or more of the following groups: (a) He/she has worked on the thesis topic for a year or two while being employed before enrolling at Stanford. (b) He/she chose a topic that was strictly petroleum engineering. Therefore, no additional courses were necessary. (c) He/she was smart and a recent graduate, hence more time was spent on research in the early quarters because he/she could spend a minimum of time revising the coursework.

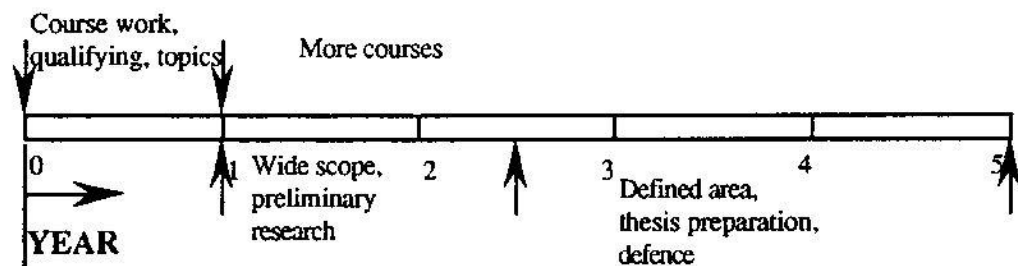


Fig.1 PhD schedule

3.2 Masters programs

For MS students, the duration is usually six quarters or 1.5 years. The students take three quarters of courses and some research is conducted at the same time. The next two to three quarters are spent entirely on research.

Another degree that is offered by Stanford is the Masters of Engineering. Students usually take eight to ten quarters to finish. The thesis is of a higher level than the masters level. One student did very well on his research and he was awarded a PhD after completing the coursework requirement. Students who failed their PhD qualifying are also given the opportunity to switch to the engineer's program.

4.0 Granting of degrees

Among others, the main requirements for granting a PhD are (1) passing the qualifying examination

(2) completing 45 units of coursework and (3) completing and defending a dissertation successfully. Other requirements such as residence, full time status, teaching experience must also be satisfied. However, the hurdles are the qualifying examination and the dissertation.

A candidate must have a reading committee, comprising of the advisor and at least two other professors. The defence committee consists of the reading committee, another professor and a chairperson from another department.

At the defence, the candidate gives a 40 to 45 minute presentation which is opened to the public. The candidate then defends his/her thesis to the defence committee only. If the student passes, a period of one year is given for modifying the dissertation according to the suggestions given during the defence. The final version of the thesis must be approved by the advisor before being sent to the Graduate school. The Graduate school's approval means that the years of hardwork have paid off.

The MS and MEng reports are graded by his/her advisor only.

5.0 PhD Program

The problem of adjusting to a different lifestyle varies from one person to another. Having lived overseas before, cultural problems did not pose as big a problem to me as it would to a first timer. However, there were still a lot of cultural and environmental differences to consider.

5.1 Early stage

Academically, the courses impose a heavy load. Most courses have a midterm, six or seven assignments and a final. At the high end, a course may have two midterms, 18 (eighteen) assignments and one final. At the low end, a course may have one midterm, four assignments and a final. Each assignment may take from three hours to twenty hours to complete. The courses that I took were graduate level mostly and were offered in the various engineering departments as well as the computer science department. Computer assignments were especially time consuming and even with excellent computer facilities, crashes still occurred. Considering that each quarter has 10 weeks of classes, a student who takes 12 credits may have two or three assignments per week.

On entering a school, a lecturer is subjected to a student environment. He/she is now a full time student. The presence of other graduate students who are in the same boat provides support and at the same time competition. Since half of the students at Stanford are graduate students, a wide range of research areas with excellent, dedicated researchers are available. Numerous seminars within the department and the school allow students a wider look at his/her interest. Consequently, given the environment and the exposure, a student has a better basis for choosing a topic. While, having a topic before enrollment may save some time, full advantage of the University's offering is not used. Better and more up-to-date research topics are often available. Schools that may not have Stanford's capacity would still have a lot to offer in terms of group discussions and seminars.

For UTM lecturers who teach, supervise and are involved in various committees, it would be difficult to start doing research before going for their PhDs due to the insufficient time given for research. A networking of researchers is still lacking and computer facilities are limited. In a research environment, library and computer facilities are available 12 to 24 hours a day for most of the year. A working (employed) environment is not conducive to research that is in the brainstorming stage. Therefore, the SLAB requirement for a thesis proposal during the application stage is unrealistic.

For example, my initial area of interest was in simulation of enhanced oil recovery processes which involves compositional modelling. At Stanford, speakers from industry spoke of the development of compositional simulators that was intensely investigated in the commercial sector. A

less investigated area in 1986 was simulation using parallel computers which became the area for my research.

5.2 Middle Stage

It is important that the general progression of research be allowed. A topic only gives a broad area, and this is narrowed when investigations begin. The scope of any research should be flexible enough to allow for interesting, unexpected discoveries and approaches.

Sometimes, it is necessary to modify one's scope if other researchers beat you to it and published similar work. By early 1988 when I was studying basic parallel programming, at least five papers on parallel simulators were presented at SPE conferences. A scary discovery was a 1987 thesis on almost the same topic as mine.

During the early times of research, the main problem is to fit the research objectives to one's capability and time schedule, and still be acceptable as PhD material. While published material, group discussions and seminars are essential to research, the amount of information gathered can be overwhelming and often bring self doubts. At this stage, the role of an advisor is crucial in keeping a student towards his/her goals by, in my case, reminding the student of the scope of work and giving pep talks. A supportive environment can mean the difference between a failure and a success.

5.3 Final stage

Once the scope and objectives have been narrowed down to the 'defined' research area, the problems that one can expect are usually technical. For example, a program may have 'no mistakes' but will not run, a promising approach may fizzle out, and so on. More positive thinking, self reliance and external support must come in. Often, there seems to be no end to the tunnel.

At the very last stage of research, a student may have the problem of going too in-depth. An advisor's role, at this moment, is to ensure that the student's work is sufficient for a PhD. The advisor's work is now reversed. While he/she may have trouble pushing the student to begin investigations, the trouble now is to get the student to stop and graduate. When I told those who had been around awhile (secretaries and professors) that I would have done a better job if I had more time, the unanimous response was 'it had been said before'.

6.0 Advisor/ student Relationship

From my experience and observations of other students, the advisor's role varied from one student to another. Part of an advisor's work was to give moral support and to boost flagging student's confidence. East Asians especially seemed to be more prone to self doubts. It was, therefore, important for an advisor and his student to be able to communicate and have a good working relationship.

The advisor's academic excellence helped in getting funds, but was seldom the focus of a student/advisor relationship. Frequently, the advisor's role was to be a sounding board, mainly for new ideas, results and inferences. At times, an advisor might have steered the student away from unsuccessful techniques, or might have papers relating to one's topic. However, keeping abreast of literature could give the same result. There had been cases when the advisor only knew the fundamentals of a subject, and the student had progressed to the application level.

The main academic requirement for an advisor is similar research interest and having research experience. A summary of his/her research area and the number of students are sufficient to gauge his/her suitability. Consequently, the SLAB requirement for the curriculum vitae of prospective advisors is unnecessary, at best. The request may very well insult the recipient and embarrass the student. It may even alienate the very person with whom a student needs to have a good rapport. In

addition, UTM lecturers are restricted to enroll in universities whose professors are willing to entertain such a request and, therefore, may lose out in other areas.

7.0 Conclusion

The two SLAB requirements, that is thesis proposal and advisor's curriculum vitae, should be reviewed.

There are many interrelated factors that result in the successful completion of a PhD program. Those who have succeeded have shown great determination and hardwork. However, without a supportive environment, be it advisor or scholarship sponsors or family, determination and hardwork are not enough. While it is cheaper to finish one's study in a short time, the process of learning is slow and cannot be measured in terms of money.

A PhD program takes a toll on a person's health; physically, mentally and emotionally. To prospective candidates, remember: it ain't easy but you can do it.

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